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B2J JQ JS J101 J202 J204 J206
U1S S1272 S1820

(56) Documents cited
GB 2088250 A GB 1513699 A GB 1450992 A
GB 1153028 A GB 0993007 A GB 0922730 A

(58) Field of search
UK CL (Edition L) B2J JA JD1 JD2 JS
INT CL[5] B03C 3/01 3/32 3/36

(54) Electrostatic air cleaner

(57) An air cleaner suitable for use in an automobile, comprises an electrostatic dust collector 4 with parallel charged plates (18, 19 Figures 2 to 4) and discharge wires (21), a blower 11, a high voltage power source 5 and a mask 24 for directing incoming air to the discharge wires. The collector 4 comprises discharge plates 18 and ground plates 19, the collector case 20 (Fig 4) being resiliently mounted at 28, 29 and having grooves (25) for receiving the plates. Elastic conductive members (28, 29 Fig 5) are used to secure the plates and make electrical connections. Air entering through the inlet 2 passes between the plates (18, 19) through a filter 8 of activated carbon and over aromatic material 12 before exiting at 3. The cleaner is mounted using a thumbscrew 17.

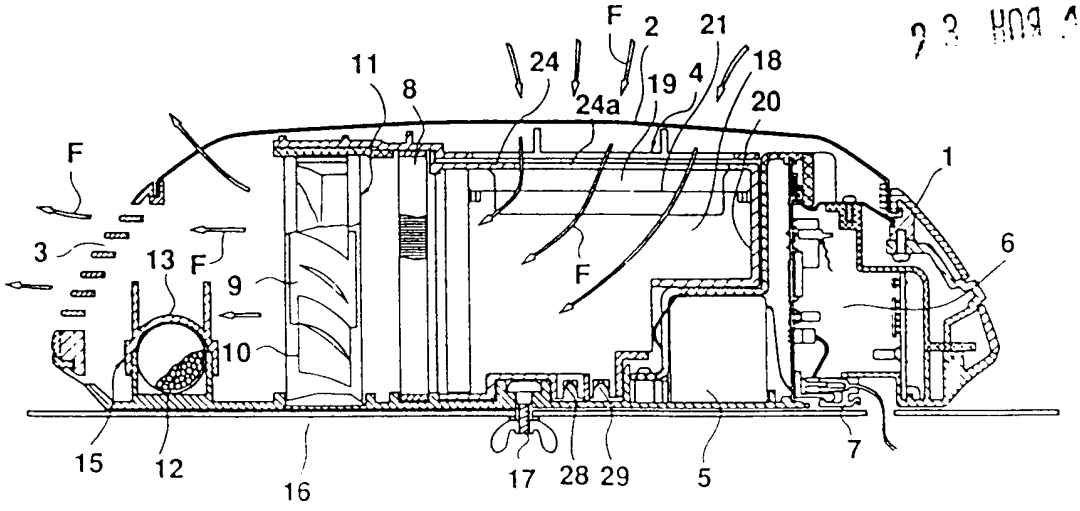

Fig. 1

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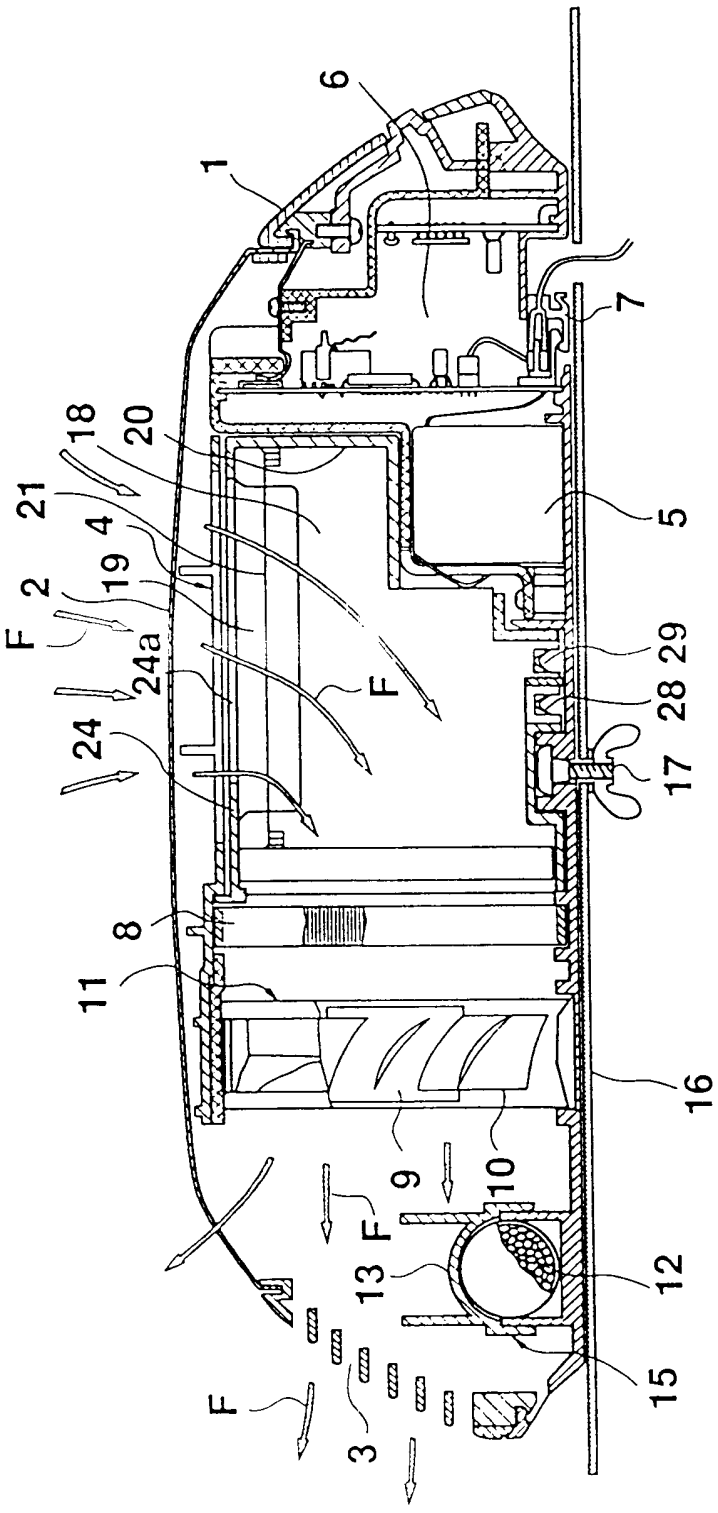

Fig. 1

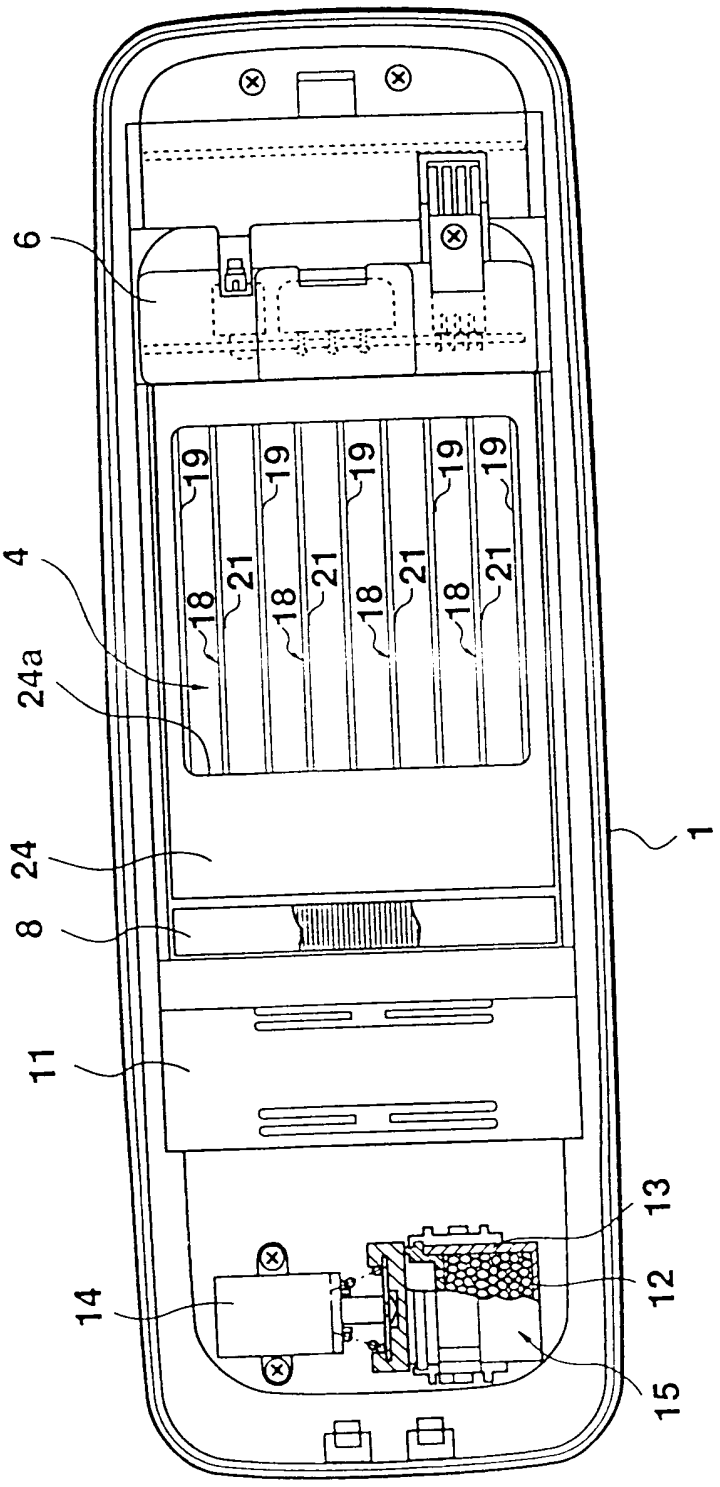

Fig. 2

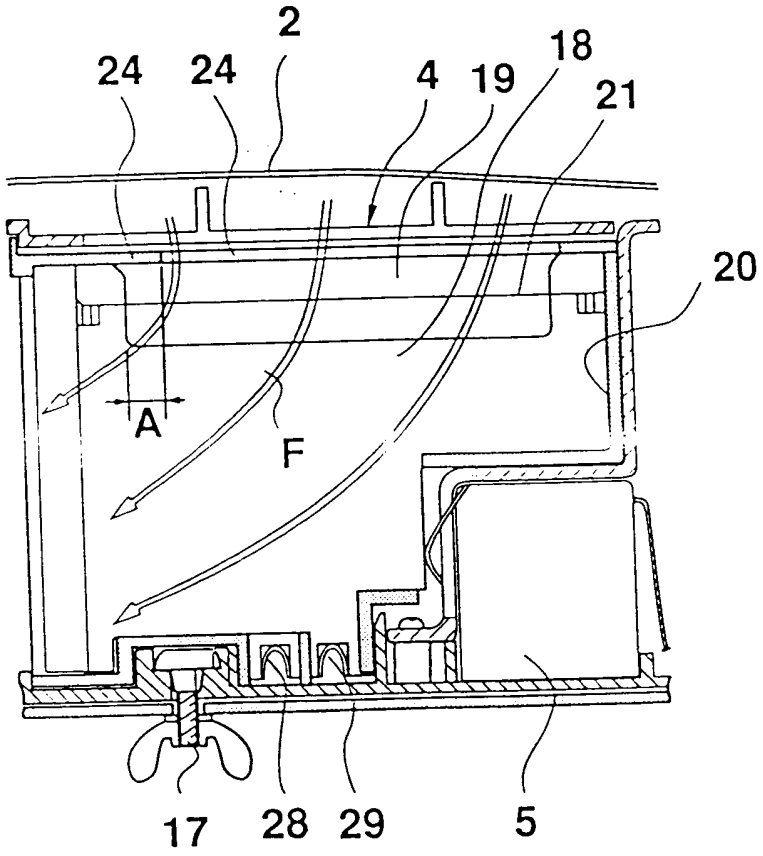

Fig. 3

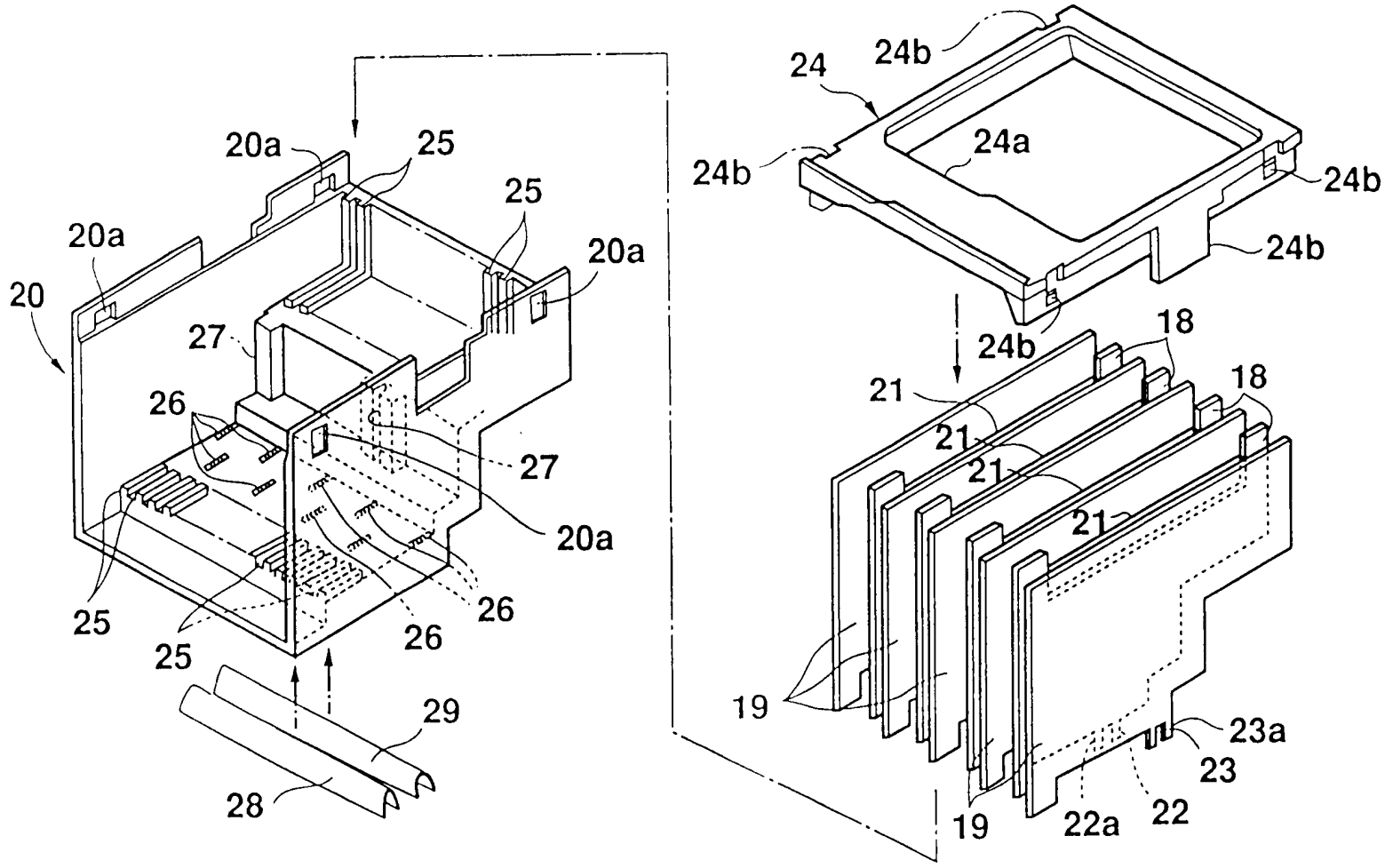
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Fig. 4

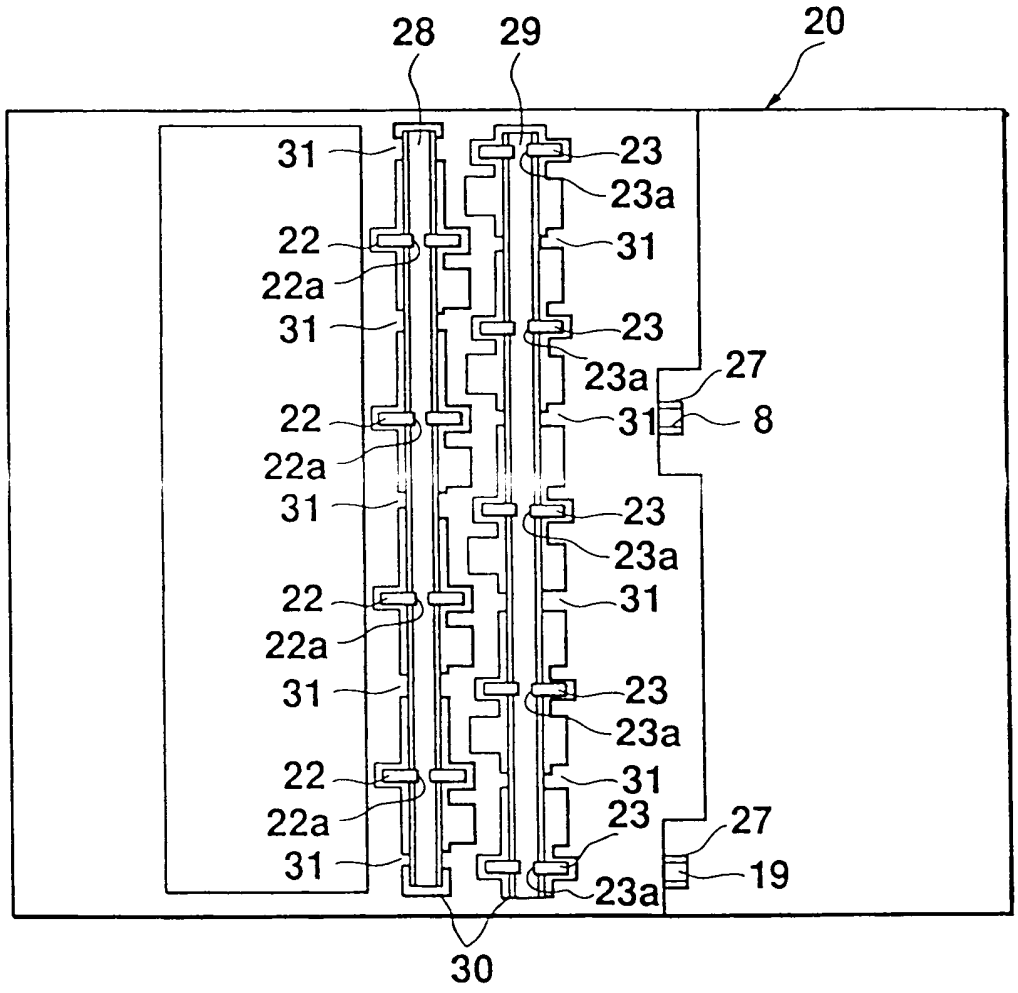
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Fig. 5

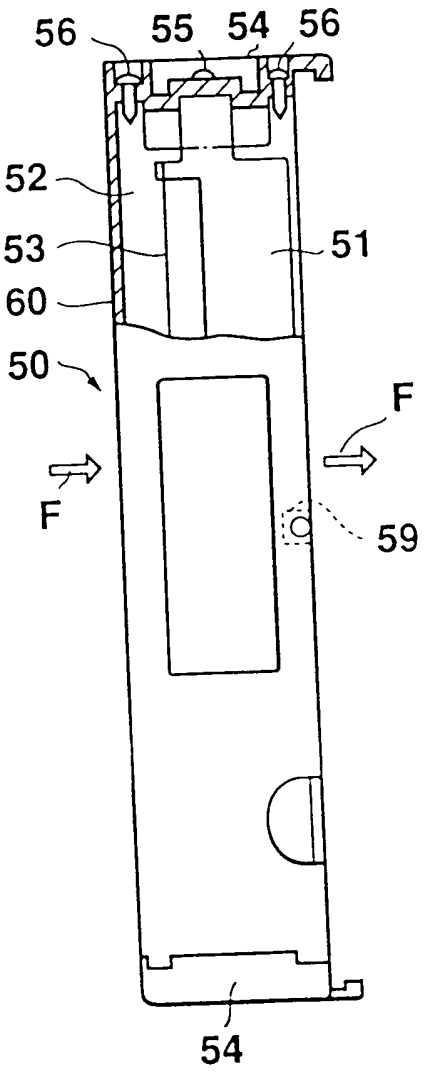

Fig. 6

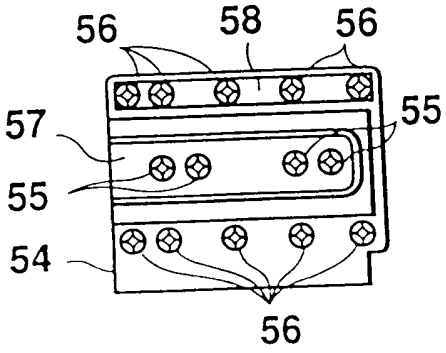

Fig. 7

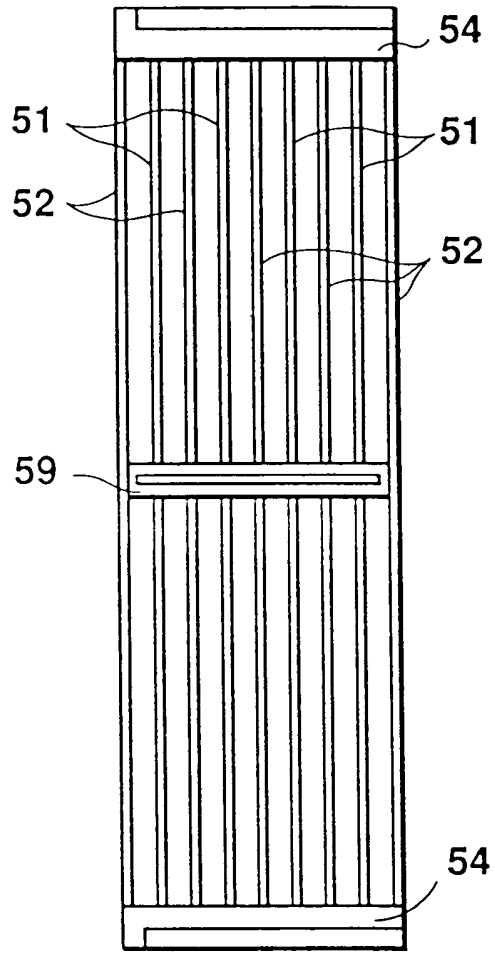

Fig. 8

AIR CLEANER

This invention relates to an air cleaner utilising corona discharge, which is located in the interior of an automobile, etc.

Figure 6 of the accompanying drawings is a partially cutaway front view of a dust collection section in a conventional air cleaner. Figure 7 is a top view of the dust collection section. Figure 8 shows the dust collection section when viewed from an expelled air side. The air flows in the direction denoted by arrow F in Figure 6. The dust collection section 50 is disposed in a main unit case (not shown) together with other components such as a high-voltage power supply and a blower for generating an air flow.

The dust collection section 50 comprises four rectangular discharge plates 51 and five rectangular ground plates 52; they are disposed alternately in parallel. Each of the discharge plates 51 is provided with a discharge wire 53 along the side facing the air being drawn in (left side of Figure 6). The opposite ends of each of the discharge plates 51 and the ground plates 52 are bent longitudinally in an 'L' shape and fixed on bases 54 with screws 55 and 56. The discharge plates 51 are electrically connected to each other by a discharge plate contact plate 57; the ground plates 52 are elec-

trically connected to each other by a ground plate contact plate 58. The longitudinally intermediate part of each of the discharge plates 51 is coupled with that of each of the ground plates 52 by an insulating spacer 59. Further, a mesh plate 60 is installed on the air intake side of the dust collection section 50.

In the configuration, when a high voltage is applied between the discharge plates 51 and the ground plates 52 of the dust collection section 50 from the high-voltage power supply, corona discharge occurs between the discharge wire of each discharge plate 51 and the ground plate 52. In this state, the blower disposed on the air expelled side of the dust collection section 50 is activated to draw in air through the mesh plate 60 and make the air flow into a gap between the discharge plates 51 and the ground plates 52 of the dust collection section. Then, comparatively large dust in the air flowing into the dust collection section 50 is removed by means of the mesh plate 60 and further, small dust which passes through the mesh plate 60 is made anodic by corona discharge occurring between the discharge wires 53 and the ground plates 52, and is absorbed into the ground plates 52.

Thus, the clean air passes through the mesh plate 60 and the dust collection section 50 of the air cleaner to remove dust and is then sent out to the outside of the main unit case.

In the air cleaner as described above, in the structure,

a portion where no corona discharge occurs outside the stretching range of the discharge wires 53 is inevitable at the opposite ends of each discharge plate 51 of the dust collection section 50 in the discharge wire stretching direction. A part of the air flowing into the dust collection section 50 is passed through the portion where no corona discharge occurs. Of course, sufficient dust collection is not made from the air passing through the portion where no corona discharge occurs.

Since air also flows into portions of the dust collection section 50 where no corona discharge occurs, the dust collection efficiency of the conventional air cleaner is lowered.

Since the discharge plates 51 and the ground plates 52 are screwed one plate at a time on the bases 54 together with the contact plates 57 and 58 to assemble the dust collection section 50, it takes time to construct the dust collection section 50.

Accordingly, it is an object of the invention to provide an air cleaner which is high in dust collection efficiency and has an easy-to-construct dust collection section.

To these ends, according to a first embodiment of the invention, there is provided an air cleaner in which a mask board is located on the air intake side of a dust collection section for converging an air flow in the discharge wire stretching range of discharge plates of the dust collection

section.

When the mask board is mounted for converging an air flow in the discharge wire stretching range of discharge plates of the dust collection section, all air flowing into the dust collection section passes through a corona discharge occurring area, thereby efficiently removing dust contained in the air flowing into the dust collection section.

According to a second embodiment of the invention, there is provided an air cleaner which comprises fixing parts with which the discharge plates and the ground plates are formed, a conductive discharge plate fixing member being engaged with the fixing parts of the discharge plates, and a conductive ground plate fixing member being engaged with the fixing parts of the ground plates. The discharge plates are connected to each other and the ground plates are connected to each other by pressing the fixing parts into contact with the fixing members corresponding thereto when the discharge and ground plates are installed, thereby eliminating the need for fixing the plates with screws or the like.

The fixing parts with which the discharge plates are formed may be arranged in a straight line when they are mounted in the plate retention case and the discharge plate fixing member engaged with the fixing parts is then formed like a straight line. On the other hand, the fixing parts with which the ground plates are formed may be arranged on another straight line not essentially crossing the straight line on which the dis-

charge plate fixing parts are located when they are mounted in the plate retention case and the ground plate fixing member engaged with the fixing parts is then formed like a straight line. Thus, the fixing members can each be made in a simple form for easier construction.

The fixing parts may be made as fixing projections projected from the discharge and ground plates. Fixing holes may be located at the positions in the plate retention case corresponding to the fixing projections, and the plates be retained with the fixing projections that pass through the fixing holes. The fixing members are then located at the positions opposite to the projected fixing parts. Thus, the fixing members are not exposed to an air flow and dirt can be prevented from accumulating on contacts. Since there are no members projected into an air flow, the air flow is not hindered and the air flow quantity is not reduced.

Each of the fixing members may be formed like a U character in section by bending rectangular plate material along the longitudinal center line, and each of the fixing parts be formed with a notch for inserting the bottom of the U character form of the fixing member. Thus, even if the fixing parts of the plates are not aligned, the uneven positions of the fixing parts can be absorbed by the elasticity of the fixing members and that of the fixing parts of the plates for bringing them into secure contact with each other.

Fixing member retention projections for holding the top

of the U shaped form of each of the fixing members may be provided in the plate retention case, thereby securing the fixing parts in the plate retention case by elasticity.

For the air cleaner whose dust collection section is constructed using the conductive, elastic fixing members, when the elastic fixing members are engaged with the fixing member engagement notches of the fixing projections of the plates, the discharge plates are electrically connected to each other and the ground plates are electrically connected to each other and the discharge and ground plates are fixed in the plate retention case at the same time, thereby easily constructing the dust collection section and shortening the construction time.

The invention will be further described by way of example with reference to the accompanying drawings in which:-

Figure 1 is a front sectional view of an air cleaner according to the invention;

Figure 2 is a top view showing the inside of the air cleaner according to the invention;

Figure 3 is an enlarged view of a dust collection section of the air cleaner shown in Figure 1;

Figure 4 is an exploded perspective view of the dust collection section of the air cleaner according to the invention;

Figure 5 shows the dust collection section of the air cleaner according to the invention when viewed from the bot-

tom;

Figure 6 is a partially cutaway front view of a dust collection section in a conventional air cleaner;

Figure 7 is a top view of the dust collection section in the conventional air cleaner; and

Figure 8 shows the dust collection section in the conventional air cleaner when viewed from the air downstream.

Referring now to the accompanying drawings, there is shown an air cleaner according to one embodiment of the invention.

Figure 1 is a front sectional view of an air cleaner according to the embodiment of the invention, wherein a punched metal cover 2 having a large number of small holes to drawn in air is installed on the top of the main unit case 1 of the air cleaner and an air outlet 3 is disposed on the left end of the main unit case 1. An air flow in the air cleaner is indicated by arrows denoted by F in the figure.

In the main unit case 1, a dust collection section 4 (described below) is located substantially at the center with a high-voltage power supply 5 below the right of the dust collection section 4, a control section 6 on the right of the dust collection section 4 and the high-voltage power supply 5, and a power connector 7 below the control section 6. Arranged at the left of the dust collection section 4 in order are a deodorization section 8 using honeycomb activated carbon, a blower 11 integral with a motor 9 and a fan 10, and a perfume

section integral with a housing 13, in which perfume 12 is housed, and a perfume control solenoid valve 14. Further, a fixing screw 17 is mounted on the bottom of the main unit case 1 to fix the main unit case 1 on a fixture board 16 provided in the interior of an automobile, etc.

As shown in Figures 1-3 and in the exploded perspective view of Figure 4, the dust collection section 4 is made of four discharge plates 18 and five ground plates 19 which are arranged sideways alternately in parallel by means of a plate retention case 20. Each of the plates 18 and 19 is substantially rectangular except that the lower right portion is cut away conforming to the location space of the high-voltage power supply 5. A discharge wire 21 is stretched in a cutaway portion formed on the top of each discharge plate 18. Further, fixing projections 22 and 23 are provided at the lower edges of the discharge plates 18 and the ground plates 19 respectively with their positions shifted. The fixing projections 22 and 23 are formed with fixing member engagement notches 22a and 23a respectively in such a manner that the lower ends are opened. The open ends of the fixing member engagement notches 22a and 23a are narrowed from both sides.

The bottom of the plate retention case 20 is stepped conforming to the forms of the discharge and ground plates 18 and 19. The top and left side of the case 20 are opened to pass an air flow through, and the deodorization section 8 and the blower 11 are linked with the left end of the opening to

prevent air from flowing from other portions. A mask board 24 having a rectangular hole 24a is installed on the top of the plate retention case 20, which is the air intake side of the dust collection section 4, by engaging lock holes 20a of the plate retention case 20 with lock projections 24b of the mask board 24. The mask board 24 is adapted to converge an air flow within the stretching range of the discharge wires 21 of the discharge plates 18, thus the rectangular hole 24a is formed by considering the stretching range of the discharge wires 21, the air flow direction, etc.

On the other hand, nine plate retention grooves 25, which are parallel to each other to retain the discharge and ground plates 18 and 19, are formed inside the plate retention case 20 by projecting ribs, and fixing holes 26 are provided on the bottom to insert the fixing projections 22 and 23 of the discharge and ground plates 18 and 19. Two long vertical slits 27 are provided at the lower part of the right side of the plate retention case 20 to expose one of the retained discharge plates 18 and one of the retained ground plates 19 to the outside of the case for connection to the high-voltage power supply 5.

When the dust collection section 4 is constructed, the discharge plates 18 and the ground plates 19 are mounted alternately in the plate retention grooves with their respective fixing projections 22 and 23 inserted in the fixing holes 26 of the plate retention case 20. Further, as shown in

Figure 5, two long elastic fixing members 28 and 29 are engaged with the fixing member engagement notches 22a and 23a of the fixing projections 22 and 23 of the discharge and ground plates 18 and 19 exposed to the outside of the plate retention case 20 through the fixing holes 26 of the case with the discharge plates 18 connected to each other and the ground plates 19 connected to each other.

Each of the elastic fixing members 28 and 29 has conductivity as well as elasticity which enables the member to be expanded and contracted in the lateral direction; in the embodiment, the elastic fixing members are formed by incurving long plates of stainless steel so as to make the section like a upturned letter U. Thus, their elasticity is used to engage the elastic fixing members 28 and 29 with the fixing member engagement notches 22a and 23a of the fixing projections 22 and 23 of the discharge and ground plates 18 and 19, thereby fixing the discharge and ground plates 18 and 19 in the plate retention case 20 with the discharge plates 18 electrically connected to each other and the ground plates 19 electrically connected to each other.

The dimensions, etc., of the fixing member engagement notches 22a and 23a slightly vary because the intervals between the fixing projections 22 of the charge plates 18 and between the fixing projections 23 of the ground plates 19 are comparatively long (about 9 mm). In such a case, the elastic fixing members 28 and 29 can also be engaged with their re-

spective notches 22a and 23a with the members 28 and 29 securely brought into contact with all of their corresponding fixing projections 22 and 23 by their elasticity. Moreover, since the open ends of the fixing member engagement notches 22a and 23a are narrowed from both sides as described above, the engaged elastic fixing members 28 and 29 will not fall off. Two fixing member burying recesses 30 can be formed on the lower face of the plate retention case 20 to prevent the engaged elastic fixing members 28 and 29 from falling off longitudinally. Further, if a plurality of fixing member retention projections 31 are provided in the fixing member burying recesses 30 at shift positions of the fixing projections 22 and 23 and are pressed into contact with the engaged elastic fixing members 28 and 29 for retaining them, looseness between the plates 18 and 19 and the plate retention case 20 can be secured.

In the air cleaner according to the embodiment, power is supplied from an external source through the power connector 7 to the high-voltage power supply 5 to generate high voltage (about 6 kV), and the high voltage is applied between one of the discharge plates 18 and one of the ground plates 19 exposed from the two slits 27 of the plate retention case 20. At this time, since the discharge plates 18 of the dust collection section 4 are electrically connected to each other by the conductive and elastic fixing member 28 and the ground plates 19 are electrically connected to each other by the

conductive and elastic fixing member 29, the high voltage supplied from the high-voltage power supply 5 is applied between all discharge plates 18 and ground plates 19.

When the high voltage is applied between the discharge plates 18 and the ground plates 19, corona discharge occurs between the discharge wires 21 of the discharge plates 18 and the ground plates 19. In this state, the blower 11 is activated to draw air through the punched metal cover 2 into the main unit case 1 and make the air flow from the top of the dust collection section 4 into gaps between the discharge plates 18 and the ground plates 19. At this time, the air flowing into the dust collection section 4 is converged in the stretching range of the discharge wires 21 of the discharge plates 18 by the mask board 24 mounted on the top of the plate retention case 20. That is, all the air flowing into the dust collection section 4 passes through the corona discharge occurring area.

Comparatively large dust in the air flowing into the dust collection section 4 is first removed by the punched metal cover 2, then small dust passing through the punched metal cover 2 is made anodic by corona discharge in the dust collection section 4 and is absorbed into the ground plates 19. At this time, the air always passes through the corona discharge occurring area, thus dust contained in the air can be removed efficiently.

The clean air from which dust is removed through the

dust collection section 4 is guided toward the blower 11 located at the left of the dust collection section 4 and is deodorized at the deodorization section 8 and is perfumed at the perfume section 15 as required, then is sent out from the air outlet 3 and a part of the punched metal cover 2 to the outside of the main unit case 1. The operation of the air cleaner is controlled by the control section 6.

As described above, the air cleaner according to the invention can collect dust efficiently by installing the mask board at the air upstream side of the dust collection section 4. The following problems should also be considered to determine the size and location of the rectangular hole 24a of the mask board 24: It is difficult to make corona discharge occur at the ends of the discharge wire stretching range depending on the thickness of the discharge wire 21; and if an air flow is narrowed too much, the air flow quantity that can be processed by the air cleaner lowers. In the embodiment, air flows obliquely from the top of the dust collection section toward the left, thus the left margin of the rectangular hole 24a of the mask board 24 is put to the inside. Experimentally, when the difference A between the left margin of the rectangular hole 24a of the mask board 24 and the left end of the discharge wire stretching range (see Figure 3) was made about 4 mm, the maximum dust collection efficiency was able to be accomplished, provided that the pitch between plates was 9 mm, that the thickness of the discharge wire 21 was 100 μm, that

the applied voltage was 6 kV, and that the air flow rate was 1.5-2 m/s.

The two elastic fixing members 28 and 29 are engaged with the fixing member engagement notches 22a and 23a of the fixing projections 22 and 23 of the discharge and ground plates 18 and 19, thereby fixing the discharge plates 18 and the ground plates 19 in the plate retention case 20 at the same time for easy construction of the dust collection section 4 of the air cleaner according to the invention.

CLAIMS

1. An air cleaner comprising a dust collection section in which a plurality of discharge plates carrying a discharge wire are arranged in parallel to and alternating with a plurality of ground plates, a high-voltage power supply for applying a voltage between said discharge plates and said ground plates of said dust collection section, and a blower for making air flow into a gap between said discharge plates and said ground plates of said dust collection section, for dust collection by corona discharge between the discharge wires of said discharge plates and said ground plates of said dust collection section,

wherein said air cleaner further comprises a mask board disposed on an intake side of air flow through said dust collection section for converging the air flow to the discharge wires of said discharge plates of said dust collection section.

2. An air cleaner comprising a dust collection section containing a plate retention case in which a plurality of discharge plates carrying discharge wires are arranged in parallel and alternating with a plurality of ground plates, a high-voltage power supply for applying a voltage between said discharge plates and said ground plates of said dust collection section, and a blower for making air flow into a gap

between said discharge plates and said ground plates of said dust collection section, for dust collection by corona discharge between the discharge wires of said discharge plates and said ground plates of said dust collection section,

wherein said air cleaner further comprises fixing parts with which said discharge plates and said ground plates are formed;

a conductive discharge plate fixing member being engaged with said fixing parts of said discharge plates; and

a conductive ground plate fixing member being engaged with said fixing parts of said ground plates, wherein said discharge plates are connected to each other and said ground plates are connected to each other by pressing said fixing parts into contact with said fixing members corresponding thereto when said discharge and ground plates are installed.

3. The air cleaner as claimed in claim 2 wherein

said fixing parts with which said discharge plates are formed are arranged on a straight line when they are mounted in said plate retention case, said discharge plate fixing member engaged with said fixing parts being formed like a straight line; and

said fixing parts with which said ground plates are formed are arranged on another straight line not essentially crossing the straight line on which said discharge plate

fixing parts are located when they are mounted in said plate retention case, said ground plate fixing member engaged with said fixing parts being formed like a straight line.

4. The air cleaner as claimed in claim 2 or 3 wherein

said fixing parts are fixing projections projected from said discharge and ground plates,

further comprising fixing holes through which said fixing proj tions are passed, said fixing holes being located at predetermined positions in said plate retention case corresponding to positions of said fixing projections,

said fixing members being opposite to said fixing holes and located outside said plate retention case,

wherein portions of said fixing parts passed through said fixing holes and projected to the outside of said plate retention case are pressed into contact with said fixing members.

5. The air cleaner as claimed in claim 3 or 4 wherein

each of said fixing members is formed like a U shaped in section by bending rectangular plate material along a longitudinal center line; and

each of said fixing parts has a notch, wherein the bottom of the U shaped form of each of said fixing members is inserted into said notches of said fixing parts.

6. The air cleaner as claimed in claim 5 further including fixing member retention projections for holding the top of the U shaped form of each of said fixing members, said fixing member retention projections being provided in said plate retention case.

7. An air cleaner constructed and arranged to operate substantially as hereinbefore described with reference to and as illustrated in Figures 1 to 5 of the accompanying drawings.

8. A vehicle including an air cleaner according to any one of the preceding claims.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number
GB 9306728.8

Relevant Technical fields

(i) UK Cl (Edition L) B2J (JA,JD1,JD2,JS)

(ii) Int Cl (Edition 5) B03C (3/01,32,36)

Search Examiner

MR J L FREEMAN

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search

17 JUNE 1993

Documents considered relevant following a search in respect of claims 1

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
A	GB 2088250 A (BURGESS) Figure 7	1 & 2
A	GB 1513699 (ALPHA DENSHI) Figure 1	1 & 2
X	GB 1450992 (METALLGESELLSCHAFT) Page 1 line 21	1
X	GB 1153028 (METALLGESELLSCHAFT) Page 1 lines 16 & 70	1
X	GB 993007 (METALLGESELLSCHAFT) Page 1 line 28	1
X	GB 922730 (METALLGESELLSCHAFT) Page 1 line 27	1

Category	Identification of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

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P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

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